Data Report on Sediment Properties and Macrofaunal Communities Collected at Sir Edmund Bay, British Columbia

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DATA REPORT ON SEDIMENT PROPERTIES AND MACROFAUNAL COMMUNITIES COLLECTED AT SIR EDMUND BAY, BRITISH COLUMBIA

by

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ABSTRACT

Sutherland, T.F., Levings, C.D., Petersen, S.A., Sinclair, D., Jepps, S., Knight, J., Gillard, B., Knapp, W., and McPhie, R. 2005. Data report on sediment properties and macrofaunal communities collected at Sir Edmund Bay, British Columbia. Can. Data. Rep. Fish. Aquat. Sci. 1165: v + 21p.

A benthic sampling survey was carried out at a finfish aquaculture site situated in Sir Edmund Bay located on the northeast shoreline of Broughton Island, British Columbia. Both Van Veen grab samples and gravity cores were collected near the netpen system in Sir Edmund Bay and also at a reference site in Penphrase Passage. The grab samples were analyzed for sediment grain size, total nitrogen and carbon content, trace-metal concentration, and macrofaunal abundance, while the core samples were analyzed for sediment sulphide concentration and redox potential. The data resulting from these surveys are presented in this report.

RÉSUMÉ

Sutherland, T.F., Levings, C.D., Petersen, S.A., Sinclair, D., Jepps, S., Knight, J., Gillard, B., Knapp, W., and McPhie, R. 2005. Data report on sediment properties and macrofaunal communities collected at Sir Edmund Bay, British Columbia. Can. Data. Rep. Fish. Aquat. Sci. 1165: v + 21p.

Une campagne d'échantillonnages benthiques a été effectuée sur un site de pisciculture se trouvant dans la baie Sir Edmund, au nord-est de l'île Broughton, en Colombie-Britannique. La campagne a consisté à effectuer un échantillonnage ponctuel à la benne Van Veen et des carottages par gravité près des dans les parcs en filets présents placés dans la baie Sir Edmund et sur un site de référence se trouvant dans le passage Penphrase. Les échantillons ponctuels ont été soumis à des analyses granulométriques, chimiques (et à des analyses visant à établir la teneurs en azote, et en carbone et en , la concentration de métaux en traces) et biologiques et l'(abondance de la macrofaune)ique du sédiment. Les échantillons de carottes age ont été soumises à un dosage des des analyses visant à établir la concentration de sulfures et à la détermination du le potentiel redox d'oxydo-réduction des présents dans les sédiments. Ce rapport présente les résultats orte sur les données obtenues.

INTRODUCTION

Background

The accumulation of particulate waste material on the benthic environment within the vicinity of a salmon farm operation may have significant environmental effects. Organic enrichment can potentially lead to an increased oxygen demand in sediments producing anaerobic conditions, which can influence the abundance and diversity of an existing benthic community (Henderson and Ross, 1995). The potential for a benthic impact at Sir Edmund Bay (Figure 1) was investigated by the Science Branch as per a request put forward by the Habitat Enhancement Branch in March, 2003.

Site Characteristics

Sir Edmund Bay is located on the northeast corner of Broughton Island within the Broughton Archipelago situated on the south-central coast of British Columbia. The bay is approximately 1000 m long and 750 m wide with a maximum depth of 75 m. Nicholls Island is situated at the entrance of the bay. The aquaculture lease site is positioned at the northeastern shoreline near the entrance to Sir Edmund Bay. The production cycle that led up to the field sampling took place between March, 2001 and March, 2003, with the final live harvest reaching 4070 tonnes and mortalities reaching 1069 tonnes. Two netpen systems were used for the latest production cycle with one netpen system (southern) remaining during the benthic field survey (Figure 3). There were no fish present in the netpens while sampling occurred. An ROV survey and a benthic grab and core survey were carried out at this site on August 26th, 2003 and between June 24 and 27, 2003, respectively.

METHODS AND MATERIALS

ROV SURVEY

A Deep Ocean Phantom HD2 ROV was used to conduct a video assessment of the benthic environment of the Sir Edmund Bay fish farm lease site using the support Fisheries patrol vessel, Manyberries (12.5 m) on August 26th, 2003. This survey consisted of four predetermined transects which ran along the sampling grid lines starting with stations 41, 51, 61, and 71. Due to obstacles such as the existing netpen structure, abandoned anchors and lines, each transect was surveyed in portions by the ROV as outlined in Figure 2.

FIELD SAMPLING

A square-shaped sampling grid was designed to span the majority of the aquaculture lease area located in Sir Edmund Bay. The grid system was comprised of 100 sampling stations arranged in a 10 x 10 pattern with a 30 m distance between stations. This sampling grid was used as a template for station selection *in situ* according to netpen position as well as grab or core observations. Grab and core samples were also obtained from three reference stations in the adjoining passage (Penphrase Passage). A Van Veen grab (0.1 m^2) was used to collect benthic

organisms and sediment chemistry samples. A Pedersen gravity corer with modified core barrels (avg. length 75 cm) was used to collect sediment cores that were analyzed for sulphide concentration and redox potential. For locations of grab and core deployments for various sediment parameters see Figure 3. Stations near to the netpen structure were sampled from the Manyberries while far-field stations were sampled from the C.C.G.S. Vector. GPS coordinates on the Manyberries were taken using a Garmin GPS II Plus (model GR-145-00214). GPS coordinates on the Vector were taken using a handheld Garmin GPS 12.

The Van Veen grab samples were visually examined for sediment colour, texture, odour and presence of living organisms as well as biofilms. The first successful grab sample collected for macrofaunal analysis at each station was sieved using a 1.0 mm screen, a 0.5 mm screen, and a catching basin in series. Seawater was used to sieve each sediment sample using the support vessel's firehose equipped with a 0.5 mm screen. Following the sieving process the 1.0 mm screen was thoroughly inspected for retained organisms which were removed with forceps and added to a labelled sample jar. Next the material on the 0.5 mm screen was transferred to the labelled sample jar and preserved with 10% formalin. The second successful grab at each station was placed unopened in a large plastic basin. The top doors of the grab were opened and the surface water was allowed to drain from the sample. Three surface subsamples were then collected for sediment grain size, carbon/nitrogen and semi-trace metal analysis. For each surface subsample, material from the uppermost 2 cm of the undisturbed sediment was collected using a spatula and transferred into labelled sample jars. One hundred mL plastic jars were used for both semi-trace metal and carbon/nitrogen samples, 250 mL jars were used for sediment grain size samples. Samples were frozen immediately and transported on ice in coolers until analysis.

The gravity corer was used to determine vertical profiles of sediment sulphide and redox potential in sediment. The corer was fit with core barrels of differing lengths to compensate for bottom seabed type at each station. Two-cm subsampling ports were drilled into the side of the core barrels in a spiral pattern every 2 cm along the length of each core barrel. These subsampling ports were covered with a continuous piece of duct tape in order to maintain the suction of the coring device during deployment. The bottom edges of the barrels were bevelled slightly to ease sediment penetration. During the retrieval process, a plastic cap was placed over the bottom of the core barrel and secured with electrical tape once it broke the surface water. The core barrel was then removed carefully from the corer and capped at the top.

The calibration of sulphide and redox probes took place immediately prior to core collection according to Wildish et al. (1999). Redox potential measurements were taken using an Orion combination platinum redox electrode (Orion 9678BN) in series with an Accumet AP63 portable meter. The redox electrode was filled with a 4M Ag/AgCl filling solution (Orion 900011) 24 hours prior to use. Zobell's A and B solutions were prepared so that the redox electrode could be periodically checked to ensure proper functioning. The redox potential of the sediment in each subsampling port was measured allowing the redox electrode 3 minutes to equilibrate.

Sulphide measurements were obtained using an Orion silver/sulphide electrode (Orion 6916BN) and an Accumet AP63 portable meter. The silver/sulphide electrode was filled with Optimum results "A" filling solution (Orion 900061) 24 hours prior to use. The silver/sulphide electrode was calibrated using three solutions made from sodium sulphide nonahydrate with concentrations of 10000, 1000 and 100 μM respectively. Several bottles of sulphide anti-oxidant buffer were also prepared to aid in sample analysis. The excess surface water was drained from

each core barrel using ports located well above the sediment-water interface. A 10-cc plastic syringe was inserted into each sampling port and a subsample was removed. The subsample was mixed with an equal volume of sulphide anti-oxidant buffer in a glass beaker and the sulphide concentration (μM) was measured using the silver/sulphide electrode.

LABORATORY ANALYSIS

The surficial sediment subsamples were delivered to Environment Canada's Pacific Environmental Science Centre (PESC), North Vancouver, British Columbia, for trace-metal, total nitrogen and total carbon. Particle size analysis was conducted at Soilcon Laboratories Ltd., Richmond B.C. The preserved samples were sent to Biologica Environmental Services Ltd., Victoria, British Columbia, for invertebrate enumeration and general sample description.

Trace-metal Analysis

A subsample of sediment from one of the three sample jars collected at each station was removed and placed in a 16 dram plastic vial with a snap closure, ¼ to ½ full. These subsamples were then analyzed according the PESC SEDMET Method V 6.0, using an Optima 4300 Inductively Coupled Plasma Emission Spectrometer (PerkinElmer Life and Analytical Science, Woodbridge, ON). This procedure tests for content of: aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, phosphorous, potassium, selenium, silicon, silver, sodium, strontium, sulphur, tin, titanium, vanadium, and zinc. Sediment lithium content was determined using Perkin Elmer Elan 6000 Inductively Coupled Plasma Mass Spectrometer (ICP-MS) according to procedures outlined in PESC SEDICP-MS Method V 1.0.

Total Nitrogen and Carbon Analysis

The total nitrogen concentration of the sediment samples was determined using the PESC TN Method V 2.0 automated, colorimetric, persulphate digest cadmium/copper reduction. Percent total carbon determinations were made by Pacific Soil Analysis Inc., Richmond, British Columbia. Determinations were made using a 12% $CaCO_3$ standard and performed in a 2500° F oven.

Sediment Grain Size Analysis

The sediment grain size analysis on the benthic sediment samples was carried out according to the Ocean Dumping Extra Points format (Soilcon, 2003). Each sample was first put through a 2.0 mm dry sieve. The remaining sample was then wet sieved through 1.0 mm, 0.5 mm, 0.25 mm and 0.125 mm sieves. Finally the remaining sediment solution was stirred and 20 mL subsamples removed with a volumetric pipette at predetermined time intervals to determine the soil fractions less than 0.063 mm, 0.004 mm and 0.002 mm. The particle size data was also merged and presented in the standard Ocean Dumping format which consists of four broader categories: <0.004 mm, 0.004 - 0.63 mm, 0.63 - 2.00 mm, >2.00 mm.

Macrofauna Analysis

For the macrofauna analysis, a Rose Bengal stain was added to the samples to stain organisms pink and help facilitate the sorting process. Five mL fractions of a sample were sorted in a gridded dish using a dissection microscope (10 to 30 x magnification) removing all organisms with forceps. Each dish was sorted at least twice. In terms of sorting quality assurance, the debris was retained and a portion from each jar was spread in a 9 x 13 in. white pan and examined under a dissection microscope at 12 x magnification. If greater than 2 organisms were recovered the entire sample was resorted and subjected to another spot check. A sorting efficiency was calculated based on the results of the re-sorts. The entire sample was sorted in this manner. In terms of taxonomic verification, sorting identifications of the observed organisms were verified by a taxonomist. When incomplete specimens were present only anterior portions were counted. Colonial organisms such as bryozoa, hydrozoa and cnidarians were counted as colony fragments, not as species or individuals. Identified organisms were stored in 70% ethanol in labelled vials.

Debris Description

The retained debris portion of the preserved samples was subjectively quantified by numerical abundance and debris type. Wood, mineral material and shell fragments were then measured to the nearest 0.5 cm. If the mineral portion of the debris was < 0.2 cm it was called sand, silt or clay depending on a subjective judgement by the observer. Material > 0.2 and < 0.5 cm were called gravel (< 0.5 cm), and gravel larger than 0.5 cm was measured to the nearest 0.5 cm.

ACKNOWLEDGEMENTS

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REFERENCES

Henderson, A.R., and Ross, D.J. 1995. Use of macrobenthic infaunal communities in the monitoring and control of impact of marine cage fish farming. Aquacult. Res. 26: 659 – 678.

Pacific Environmental Science Centre. ICP-MS Method V 1.0.

Pacific Environmental Science Centre. SEDMET Method V 6.0.

Pacific Environmental Science Centre. TN Method V 2.0 automated, colorimetric, persulphate digest cadmium/copper reduction.

Soilcon. 2003. Lab methods, soil physical properties, particle size analysis. http://www.soilconlabs.com. (Accessed Jan 15, 2003).

Wildish, D.J., Akagi, H.M., Hamilton, N., and Hargrave, B.T. 1999. A Recommended Method for Monitoring Sediment to Detect Organic Enrichment From Mariculture in the Bay of Fundy. Can. Tech. Rep. Fish. Aquat. Sci. 2286: 31 p.

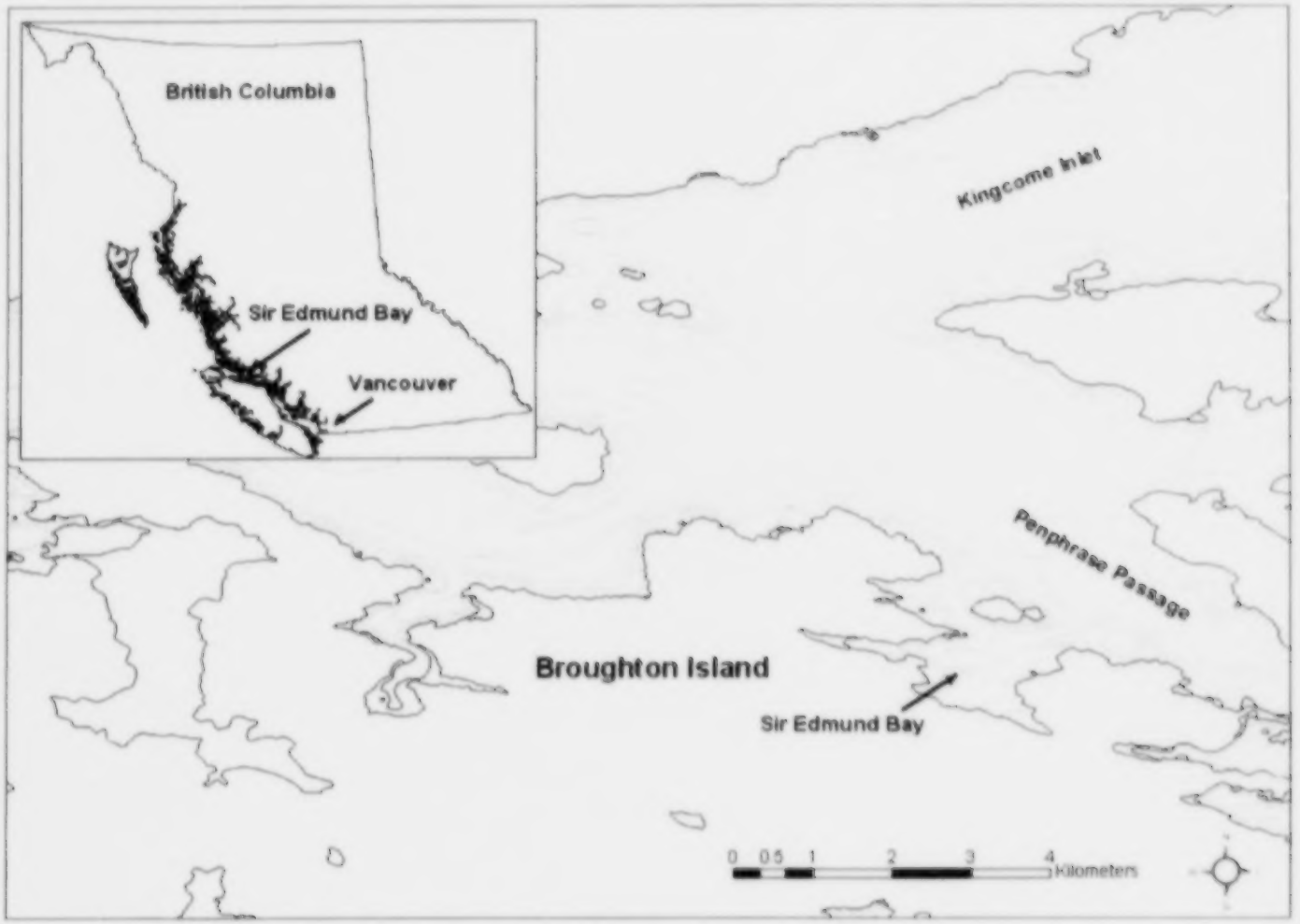

Figure 1. Location of Sir Edmund Bay, British Columbia.

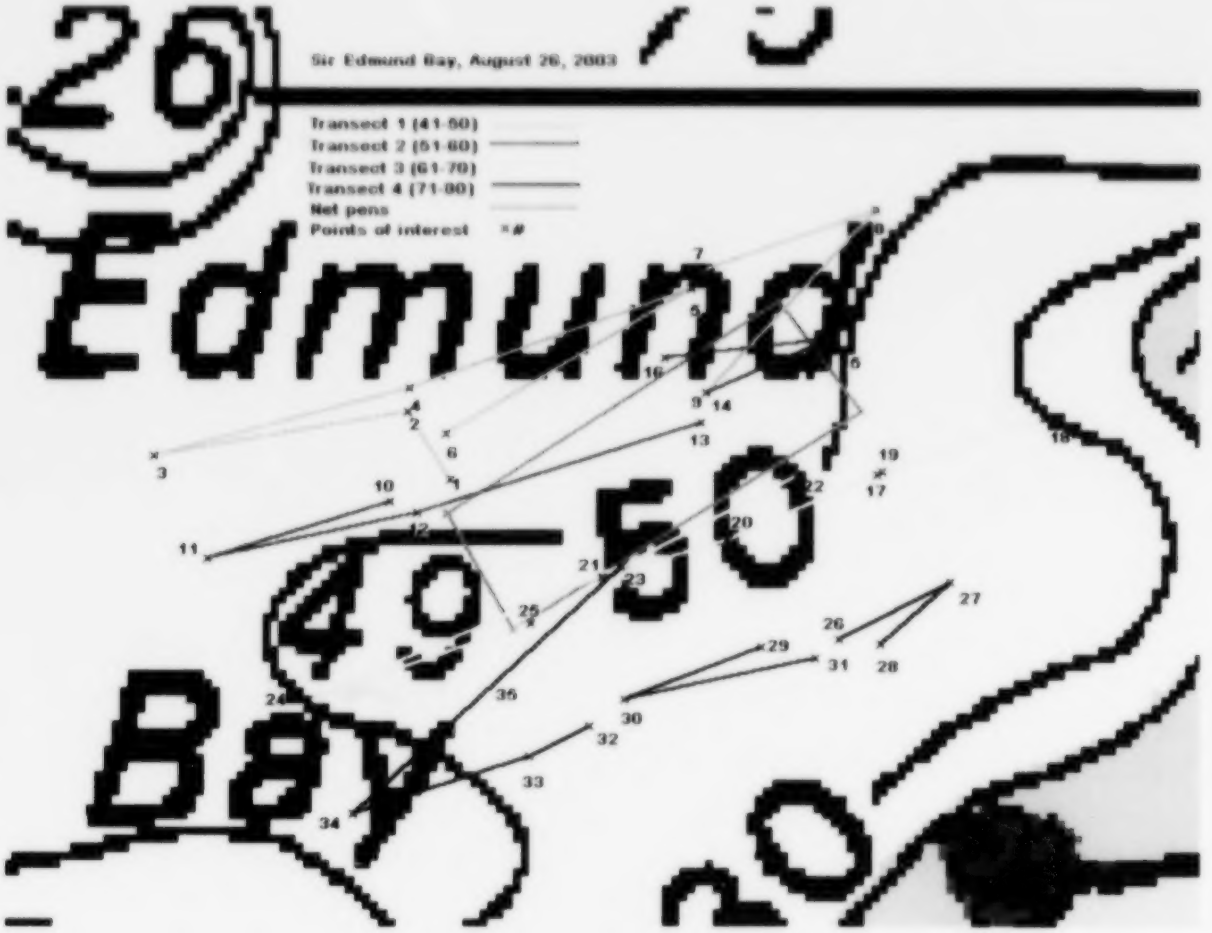

Figure 2. Location of ROV dives at Sir Edmund Bay, British Columbia.

Table 1. Summary of ROV dive information for transects T1 and T2 at Sir Edmund Bay, British Columbia on August 26th, 2003. Subtransect endpoints shown in Figure 2 are specified in column 1 next to transect number.

Transect	Time (PST)	GPS Location	Description	General Observations
T1 : 1	1141	N 50° 49.893'	Start of dives	T1: Observed gobies, pricklebacks, flatfish, dogfish and
		W 126° 35.929'		ratfish. Also observed quillback and copper rockfish as
T1 : 2	1147	N 50° 49.111'	Midway on T1 (41-50)	well as a single green urchin. Encrusting/sedentary
		W 126° 35.947'		organisms (such as cup coral, sea squirts and serpulids)
T1 : 3	1201	N 50° 49.899'	SW end of T1 (41-50)	were observed on rocks.
		W 126° 36.052'		
T1 : 4	1209	N 50° 49.917'	Returning to midway T1 (41-50)	
		W 126° 35.946'		
T1 : 5	1228	N 50° 49.942'	T1 (41-50) 80% complete	
		W 126° 49.830'		
T1 : 6	1236	N 50° 49.905'	Surface prior to next dive	
		W 126° 35.931'		
T1 : 7	1432	N 50° 49.948'	Reposition to complete T1 (41-50)	
		W 126° 35.825'		
T1 : 8	1445	N 50° 49.964'	NE end of T1 (41-50)	
		W 126° 35.753'		
T1 : 9	1435	N 50° 49.916'	Move to T2 (51-60) close to	
		W 126° 35.823'	abandoned anchor	
T2 : 10	1247	N 50° 49.887'	Start point of T2 (51-60)	T2: Obeerved gobies, pricklebacks, flatfish, dogfish and
		W 126° 35.954'		ratfish. Also observed quillback, yellowtail and yellow
T2 : 11	1301	N 50° 49.872'	SW end of T2 (51-60)	eye rockfish as well as a lingcod.
		W 126° 36.030'		
T2 : 12	1308	N 50° 49.884'	Back to start point of T2 (51-60)	
		W 126° 35.943'		
T2 : 13	1332	N 50° 49.908'	Abandoned anchor and lines	
		W 126° 35.925'		
T2 : 14	1453	N 50° 49.916'	Repositioned near abandoned	
		W 126° 35.825'	anchor	
T2 : 15	1504	N 50° 49.930'	Abandoned line	
		W 126° 35.772'		
T2 : 16	1509	n/a	ROV turned around and slightly hung	
		n/a	up and pulled clear	

Table 2. Summary of ROV dive information for transects T3 and T4 at Sir Edmund Bay, British Columbia on August 26th, 2003. Subtransect endpoints shown in Figure 2 are specified in column 1 next to transect number.

Transect	Time (PST)	GPS Location	Description	General Observations
T3 : 17	1542	N 50° 49.894' W 126° 35.752'	Repositioned to T3 (61-70)	T3: Observed gobies, pricklebacks, flatfish, dogfish and ratfish. Noted presence of quillback rockfish and perch.
T3 : 18	1559	N 50° 49.909' W 126° 35.683'	Most NE end of T3 (61-70)	Higher portion of finer sediments. Bubbles seen coming from sediment after disturbed by ROV manipulator arm. Clumps of tube worms (possibly *Eudistylia vancouveri*) as well as colonies of serpulid worms.
T3 : 19	1609	N 50° 49.895' W 126° 35.750'	Return to start point of T3 (61-70)	
T3 : 20	1622	N 50° 49.877' W 126° 35.814'	Point of interest	
T3 : 21	1629	N 50° 49.867' W 126° 35.866'	End of 1st dive at T3 (61-70)	
T3 : 22	1635	n/a n/a	ROV approximate surface location	
T3 : 23	1857	N 50° 49.870' W 126° 35.858'	Repositioned to complete T3 (61-70)	
T3 : 24	1916	N 50° 49.835' W 126° 35.988'	Most SW end of T3 (61-70)	
T3 : 25	1923	n/a n/a	More anchor lines. Approximate surface location. End of day.	
T4 : 26	1711	N 50° 49.851' W 126° 35.768'	Near a 5 tonne anchor. Took southerly route off T4 to prevent entanglement.	T4: Observed gobies, pricklebacks, flatfish, dogfish and ratfish. Also noted presence of perch and a large skate. visibility better on transects 3 and 4. Encrusting/ sedentary organisms observed on rocks.
T4 : 27	1727	N 50° 49.866' W 126° 35.722'	Most NE section of T4 (71-80)	
T4 : 28	1735	n/a n/a	More obstructions. Umbilical pulled for recovery. Position approximated.	
T4 : 29	1746	N 50° 49.849' W 126° 35.800'	Repositioned ROV to continue dives at T4 (71-80)	
T4 : 30	1754	N 50° 49.835' W 126° 35.857'	End of this section of T4 (71-80)	
T4 : 31	1758	n/a n/a	Pulled to surface to avoid overhead obstruction	
T4 : 32	1832	N 50° 49.828' W 126° 35.871'	Start of last section of T4 (71-80)	
T4 : 33	1839	N 50° 49.820' W 126° 35.896'	Start of boulder section	Various items of human origin were also observed on the transects including pop cans, a chair, piping and a computer.
T4 : 34	1846	N 50° 49.805' W 126° 35.969'	SW end of T4 (71-80)	

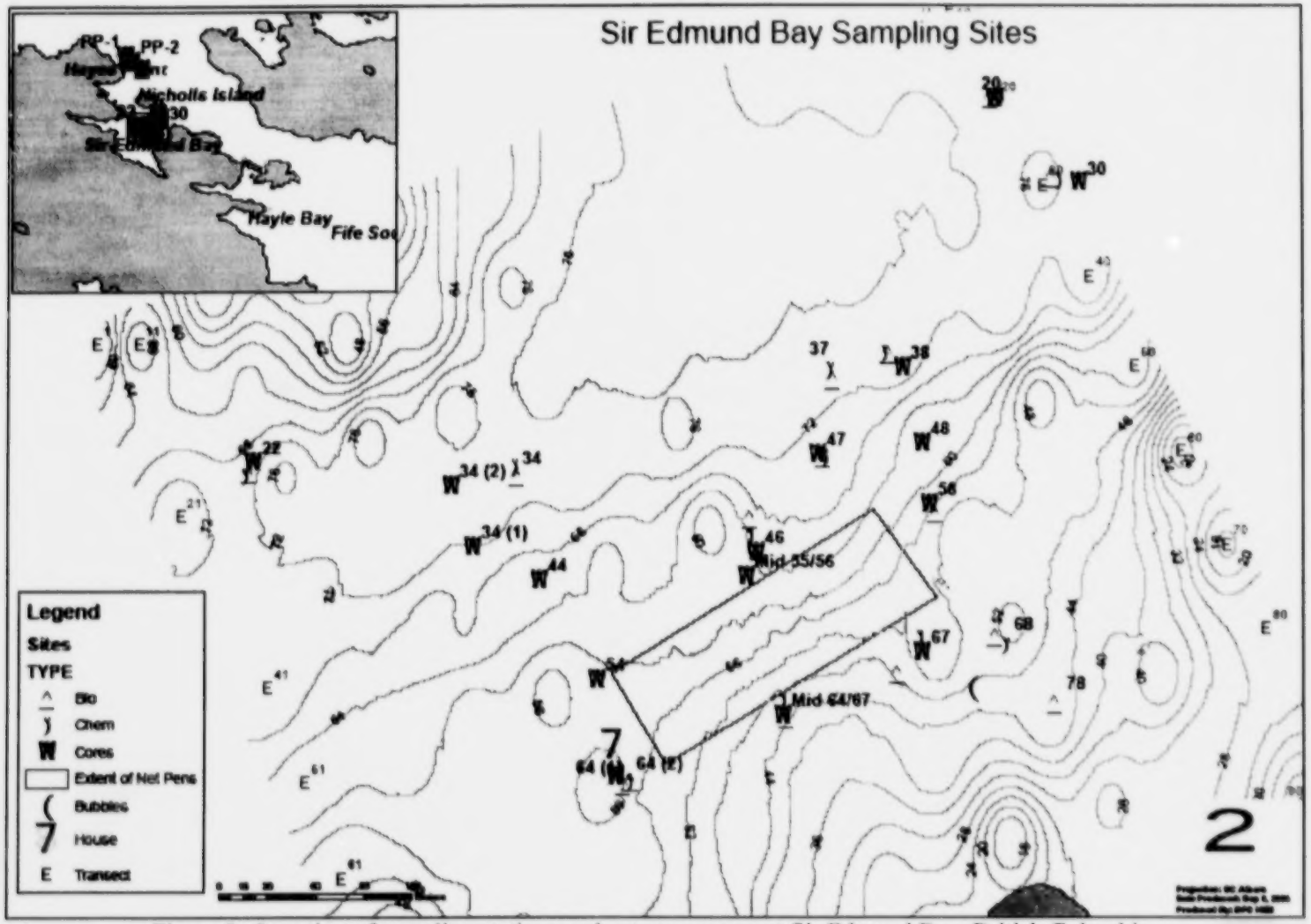

Figure 3. Location of sampling stations and net pen system at Sir Edmund Bay, British Columbia.

Table 3. GPS coordinates of netpen structures at Sir Edmund Bay, British Columbia.

South Pen Corners

Latitude	Longitude
N 50° 49.912'	W 126° 35.751'
N 50° 49.841'	W 126° 35.900'
N 50° 49.871'	W 126° 35.927'
N 50° 49.940'	W 126° 35.780'
N 50° 49.910'	W 126° 35.750'

North Pen Corners

Latitude	Longitude
N 50° 49.960'	W 126° 35.800'
N 50° 49.890'	W 126° 35.940'
N 50° 49.930'	W 126° 35.980'
N 50° 49.990'	W 126° 35.840'
N 50° 49.960'	W 126° 35.800'

Table 4. Summary observations of Van Veen grab contents during biological sampling at farm and reference stations at Sir Edmund Bay, British Columbia.

Station	Date	Time (PST)	GPS Location	Depth (m)	Grab Fullness (%)	General Field Observations
SE-20	June 25, 2003	1542	N 50° 50.083' W 126° 35.734'	71.8	40	Try #3 good, depth at centre 13.0 cm, small amount of rock in jaws, polychaeta tubes (~2 mm dia.) present.
SE-22	June 26, 2003	912	N 50° 49.952' W 126° 36.123'	73.0	65	Oil slick on surface, polychaetes, greenish brown surface mud, firm and fine texture, depth at centre 14.0 cm.
SE-30	June 25, 2003	1745	N 50° 50.056' W 126° 35.702'	72.9	60	Depth at centre 13.2 cm, greenish mud, 2-3 cobbles 3-5 cm dia., polychaete tubes 1-2 mm dia.
SE-34	June 26, 2003	712	N 50° 49.952' W 126° 36.006'	73.0	50	Greyish green mud, no grit, small blackish patches on one side, no odour, depth at centre 13 cm, black mud deeper.
SE-37	June 24, 2003	1903	N 50° 49.986' W 126° 35.816'	75.6	35	Cobble with greenish brown mud, 10.2 cm centre depth, serpulid worm casings, fewer cobbles than SE-46.
SE-38	June 27, 2003	708	N 50° 49.995' W 126° 35.787'	70.3	60	Dark with thin brown glaze, rocks 3-5 cm, 11.5 cm centre depth, live gastropods, no odour, worms, live bivalves.
SE-46	June 24, 2003	1422	N 50° 49.938' W 126° 35.859'	56.1	30-50	All rocks, 11.0 cm centre depth, 1 amphipod, salmon scales, 1 rock 9x8 cm scraped, no *Beggiatoa*, 1 stick 25x1 cm.
SE-47	June 27, 2003	1206	N 50° 49.959' W 126° 35.821'	69.0	50	Living amphipods, grey brownish sand over mud, small pebbles (2-5 cm), 8.8 cm centre depth, no odour.
SE-58	June 26, 2003	1909	N 50° 49.940' W 126° 35.761'	54.1	20	Small rocks, sandy mud, low odour, amphipods on water surface, serpulid worm on rock, 8.0 cm centre depth.
SE-64	June 25, 2003	917	N 50° 49.847' W 126° 35.920'	53.7	30	10.5 cm centre depth, serpulid tubes on rock.
SE-64	June 25, 2003	908	N 50° 49.846' W 126° 35.924'	54.4	20	Rock in sample, orange flecks, strong H_2S smell.
SE-64-67	June 27, 2003	1032	N 50° 49.869' W 126° 35.839'	55.2	45	Dark grey/black w/ lighter grey under, sandy, rocks w/ dead serpulid worm, bamboo case, cedar leaf, 9.0 cm centre depth.
SE-67	June 25, 2003	1254	N 50° 49.887' W 126° 35.780'	54.9	100	17 cm centre depth, *Beggiatoa*, brownish w/ orange flecks, very loose, very sticky, bubbling, very strong H_2S.
SE-68	June 26, 2003	1745	N 50° 49.898' W 126° 35.729'	53.0	95	Fine black sediment, strong odour, trace *Beggiatoa*, few small sticks in grab but no loss, 13 cm centre depth.
SE-78	June 25, 2003	728	N 50° 49.875' W 126° 35.698'	48.9	30	10.6 cm centre depth, not slumping, dead mussel shells, greyish brown mud.
PP-1	June 26, 2003	1130	N 50° 50.754' W 126° 36.361'	66.1	95	Brown grey surface layer, 4-5 amphipods, sponge fragments, polychaete tubes, 15 cm centre depth.
PP-2	June 26, 2003	1252	N 50° 50.681' W 126° 36.182'	70.3	45	Grey brown surface, large black rock w/ small bryozoan attached, small rocks, gritty sand, 13.0 cm centre depth.
PP-3	June 26, 2003	1354	N 50° 50.609' W 126° 36.028'	49.1	100	Brownish mud surface, over light grey, cloud sponge fragment, few hydroids, centre depth max to grab hinge.

Table 5. Summary observations of Van Veen grab contents during chemical sampling at farm and reference stations at Sir Edmund Bay, British Columbia.

Station	Date	Time (PST)	GPS Location	Depth (m)	Grab Fullness (%)	General Field Observations
SE-20	June 25, 2003	1602	N 50° 50.083' W 126° 35.728'	72.9	45	Few small stones, depth at centre 12.5 cm, polychaete tubes, green, no smell, gammarid amphipods on surface.
SE-22	June 26, 2003	938	N 50° 49.951' W 126° 36.124'	73.3	70	Greenish brown, 2 gastropods, few floating crustaceans, 7 polychaete tubes 1 cm dia., depth at centre 13 cm.
SE-30	June 25, 2003	1814	N 50° 50.055' W 126° 35.697'	69.9	35	Greenish mud/sand, some pebbles, 2 cobbles (~3 cm dia.), depth at centre 10.2 cm.
SE-34	June 26, 2003	751	N 50° 49.955' W 126° 35.982'	73.0	65	Surface greyish green mud, no grit, black layer 1-2 cm below surface, 13 cm centre depth, light odour, amphipod.
SE-37	June 24, 2003	1942	N 50° 49.989' W 126° 35.817'	77.1	40	Surface slumping mud, not too much sand, black sediment at 2 cm, no *Beggiatoa* observed.
SE-38	June 27, 2003	745	N 50° 49.995' W 126° 35.788'	71.4	80	Black below green layer, 11.0 cm centre depth, no feed, no rocks, no fauna.
SE-46	June 24, 2003	1834	N 50° 49.938' W 126° 35.858'	57.1	30	Brownish green surface sample, no *Beggiatoa*, no fish food, sticks removed from C/N sample, sediment crumbling.
SE-47	June 27, 2003	1229	N 50° 49.959' W 126° 35.819'	71.1	40	1 living *macoma* spp bivalve, greyish brown pebbles, sandy mud black layer beneath, clay on bottom, 8.5 cm centre depth.
SE-64	June 27, 2003	1008	N 50° 49.844' W 126° 35.920'	54.7	70	black w/ brown floating mush, few bubbles, no organisms, 8.5 cm centre depth, 1 rock, nauseating stench, cedar twig.
SE-64-67	June 27, 2003	1058	N 50° 49.875' W 126° 35.840'	55.6	55	Black gritty texture, 1 large rock, live barnacle, live serpulid worm, cup coral, small mussels, 15.0 cm centre depth.
SE-67	June 25, 2003	843	N 50° 49.897' W 126° 35.768'	54.6	55	*Beggiatoa* streaks, sample not as loose, 10.2 cm centre depth.
SE-68	June 26, 2003	1800	N 50° 49.895' W 126° 35.723'	53.0	55	Fine black mud, moderate odour, few mussel shells, leaves, small wood pieces in jaw, jelly-like, no waste food or bubbles.
PP-1	June 26, 2003	1209	N 50° 50.748' W 126° 36.303'	67.6	80	Greenish brown mud, polychaete tubes (2mm dia.), no odour, 1 rock (4x2 cm), 1 mussel shell, 15 cm centre depth.
PP-2	June 26, 2003	1325	N 50° 50.685' W 126° 36.187'	68.4	45	4 rocks, few bryozoans, hydroids, muddy sediment, greenish surface, grey beneath, 10.2 cm centre depth, worms on rocks.
PP-3	June 26, 2003	1415	N 50° 50.608' W 126° 36.028'	49.1	45	Grey-brown sediment, brown surface, grey mud underneath, sponge fragments in all 3 samples, 13.0 cm centre depth.

Table 6. Summary of gravity core sampling information at farm and reference stations at Sir Edmund Bay, British Columbia.

Station	Date	Time (PST)	dGPS Location	Depth (m)	Length (cm)	Attempts	General Field Observations
SE-20	June 24, 2003	2058	N 50° 50.083' W 126° 35.731'	74.8	14.0	5	Changed to smaller core barrel, cores slipping out at surface, added weight, greenish brown in colour.
SE-22	June 26, 2003	1454	N 50° 49.956' W 126° 36.120'	76.1	10.0	2	Small core, brown green colour, no sulphide smell, soft sandy texture.
SE-30	June 25, 2003	822	N 50° 50.054' W 126° 35.687'	73.0	13.5	3	Lost some sample during capping, core is greenish brown.
SE-34	June 26, 2003	1349	N 50° 49.927' W 126° 36.004'	72.4	8.0	1	Small core, drifted ~150 ft. from station due to wind and current, core brown green and sandy.
SE-34	June 26, 2003	1405	N 50° 49.948' W 126° 36.016'	76.4	15.0	1	Second core closer to grid station, core brown green in colour, no sulphide odour.
SE-38	June 27, 2003	907	N 50° 49.990' W 126° 35.779'	73.3	15.0	1	Dark sediment, faint sulphide smell, sandy texture.
SE-44	June 27, 2003	832	N 50° 49.916' W 126° 35.969'	62.5	9.5	1	Small core, green brown colour, sandy texture.
SE-46	June 26, 2003	1429	N 50° 49.926' W 126° 35.855'	56.6	17.0	1	Dark layer on top, streaked with grey down through lower section of core.
SE-47	June 27, 2003	843	N 50° 49.960' W 126° 35.823'	68.4	10.0	1	Small core, sandy texture, brown green colour, no evident sulphide odour, large rock on core surface.
SE-48	June 27, 2003	854	N 50° 49.984' W 126° 35.768'	60.2	14.5	1	Sandy core, dark near surface, streaked with grey further down (4 cm).
SE-54	June 27, 2003	820	N 50° 49.882' W 126° 35.938'	54.2	18.0	4	Black deposits on top of core, some shells, rock on top of core, core green brown lower down.
SE-55-56	June 26, 2003	907	N 50° 49.918' W 126° 35.860'	55.2	12.5	1	Small core, darker sandy sediment on top with grey streaked clay layer lower down.
SE-58	June 26, 2003	924	N 50° 49.943' W 126° 35.764'	53.1	12.0	1	Rock on surface of core, sandy gravelly sediment in core, brown green colour.
SE-64	June 25, 2003	1704	N 50° 49.849' W 126° 35.928'	53.9	16.5	1	Core medium length, greenish brown, streaks of grey and black, some shells on top, shell hash throughout.
SE-64	June 25, 2003		not recorded not recorded		19.5	1	Black in colour, flocculent material rising to top, bubbles from sediment (H_2S?), strong sulphide smell.
SE-64-67	June 26, 2003	850	N 50° 49.870' W 126° 35.840'	54.0	17.0	2	Dark on surface of core, surface sandy with grey clay layer beneath, faint sulphide odour.
SE-67	June 25, 2003	1610	N 50° 49.892' W 126° 35.767'	53.9	18.5	1	Surface water heavy with particulates, large black flocculants, green brown streaked with black.
PP-1	June 25, 2003	921	N 50° 50.075' W 126° 36.307'	68.0	13.0	1	Short core, brownish green in colour, some vegetation growing on top.
PP-2	June 25, 2003	902	N 50° 50.689' W 126° 36.192'	69.0	13.0	1	Short core, greenish brown in colour, slightly sloped surface, started analyzing at 1055.
PP-3	June 24, 2003	1935	N 50° 50.604' W 126° 36.028'	50.5	62.0	3	Green brown surface, some red bacteria for ~10 cm, changing into green grey layer for rest of core.

Table 7. Sediment trace-metal concentrations observed at farm and reference sampling stations at Sir Edmund Bay, British Columbia (Van Veen grab survey).

Element	Stations Sampled														
	SE-20	SE-22	SE-30	SE-34	SE-37	SE-38	SE-46	SE-47	SE-64	SE-64-67	SE-67	SE-68	PP-1	PP-2	PP-3
	$\mu g\ g^{-1}$ (dry)														
(ICP Total)															
Aluminum	20500	17300	20000	17000	15500	14100	21400	14900	2300	15700	9830	7470	30600	28200	29500
Antimony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arsenic	0	0	9	0	8	0	12	8	15	10	24	35	12	10	11
Barium	91.2	64.2	87.6	71.9	62.6	60.8	109.0	64.0	21.9	75.7	49.6	50.8	168.0	152.0	170.0
Beryllium	0.4	0.3	0.3	0.2	0.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.5
Boron	34	29	29	24	22	18	33	21	30	23	57	95	56	54	48
Cadmium	0.0	0.0	0.9	0.0	0.9	0.9	1.3	1.1	1.6	1.6	3.1	5.0	0.0	0.0	1.4
Calcium	19500	15700	18600	17700	18000	17300	26700	25500	59100	25600	105800	145400	14600	18100	13300
Chromium	19.9	19.2	21.2	17.2	17.8	17.0	19.4	18.0	4.3	17.5	12.0	13.0	21.2	21.3	19.8
Cobalt	7.4	5.8	7.7	6.5	5.8	5.3	8.9	5.4	3.4	5.9	4.4	4.0	11.3	11.0	12.3
Copper	19.7	11.6	16.4	11.3	18.6	10.8	29.3	13.1	45.8	22.4	37.8	48.5	32.6	28.7	34.9
Iron	32000.0	28000.0	37200.0	28000.0	28700.0	29300.0	37100.0	30200.0	3980.0	29900.0	15400.0	10500.0	38300.0	39600.0	34700.0
Lead	8	0	0	0	9	0	31	0	10	8	16	0	11	10	8
Magnesium	9500	6840	8770	7150	6460	6410	10200	6720	9520	7620	7840	10400	16200	14600	16600
Manganese	376.0	325.0	375.0	278.0	288.0	278.0	384.0	281.0	113.0	297.0	218.0	186.0	654.0	584.0	652.0
Molybdenum	2	0	2	3	3	3	5	4	7	7	20	41	2	2	3
Nickel	13	9	12	10	8	8	12	8	4	10	8	11	21	20	22
Phosphorus	2190	1380	2120	2190	2890	3320	6370	6170	19700	6540	47100	64800	1430	1390	1150
Potassium	4300	3150	4000	3240	2800	2690	4710	2780	2830	3450	2380	2740	8920	7660	9260
Selenium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silicon	1210	1270	1140	554	1150	1200	1060	1330	1790	1320	995	1810	1270	1370	1970
Silver	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium	17000	8740	12900	9210	8450	7330	14700	8030	51900	9550	16400	27600	33700	28900	37600
Strontium	181.0	141.0	171.0	157.0	157.0	145.0	259.0	210.0	453.0	212.0	905.0	1240.0	172.0	186.0	160.0
Sulfur	2730	1570	2460	2420	2140	2320	3960	2810	6820	4160	7460	11800	3770	3470	6310
Tin	9	15	8	8	15	9	13	9	11	9	0	0	8	8	9
Titanium	2480.0	2290.0	2610.0	2160.0	2200.0	2120.0	2770.0	2110.0	213.0	2110.0	841.0	312.0	2770.0	2890.0	2640.0
Vanadium	102	89	127	89	97	94	117	99	9	96	57	44	100	109	94
Zinc	73.1	49.7	71.4	60.9	68.6	66.7	128.0	91.0	556.0	140.0	417.0	703.0	112.0	97.4	113.0
(ICPMS Total)															
Lithium	9.25	6.21	8.55	5.86	5.54	4.66	7.79	4.16	1.82	5.52	4.58	5.38	20.5	16.8	20.6

Table 8. Detection limits for sediment trace-metal analysis conducted with an Optima 4300 inductively coupled plasma emission spectrometer and a Perkin Elmer Elan 6000 inductively coupled plasma mass spectrometer. (PESC SEDMET Method V 6.0 and PESC ICP-MS Method V 1.0).

Element	Detection Limit ($\mu g\ g^{-1}$)
(ICP Total)	
Aluminum	8
Antimony	8
Arsenic	8
Barium	0.2
Beryllium	0.2
Boron	2
Cadmium	0.8
Calcium	20
Chromium	0.8
Cobalt	0.8
Copper	0.8
Iron	0.8
Lead	8
Magnesium	20
Manganese	0.2
Molybdenum	2
Nickel	3
Phosphorus	200
Potassium	20
Selenium	8
Silicon	8
Silver	2
Sodium	20
Strontium	0.2
Sulfur	8
Tin	8
Titanium	0.3
Vanadium	2
Zinc	0.3
(ICPMS Total)	
Lithium	0.07

Table 9. Sediment carbon and nitrogen values observed at farm and reference stations at Sir Edmund Bay, British Columbia (Van Veen grab survey).

Sampling Station	Total Organic Carbon (%)	Total Carbon (%)	Total Nitrogen ($\mu g\ g^{-1}$)
SE-20	1.54	1.56	842
SE-22	1.31	1.34	988
SE-30	1.06	1.06	817
SE-34	1.64	1.69	1380
SE-37	1.58	1.58	1140
SE-38	1.69	1.74	1520
SE-46	1.37	1.37	1080
SE-47	1.71	1.73	2210
SE-64	35.00	35.00	26900
SE-Mid 64-67	2.65	2.69	2270
SE-67	8.08	8.27	9060
SE-68	16.00	16.40	14900
PP-1	2.28	2.28	1950
PP-2	1.10	1.10	1230
PP-3	2.28	2.29	2390

Table 10. Sediment grain size fractions observed at farm and reference sampling stations at Sir Edmund Bay, British Columbia (Van Veen grab survey).

Ocean Dumping Protocol	Sampling Station													
	SE-20	SE-22	SE-30	SE-34	SE-37	SE-38	SE-46	SE-47	SE-64	SE-64-67	SE-67	SE-68	PP-1	PP-2	PP-3
Gravel, >2 mm	30.54	0.11	23.47	0.45	0.95	7.28	37.81	35.62	0.69	37.24	6.66	8.72	2.88	18.48	0.00
Sand, <2.00 mm>0.063 mm	51.33	76.67	64.21	76.26	81.11	76.99	51.34	56.72		54.68	73.77	40.40	28.79	47.30	5.12
Silt, <0.063 mm>0.004 mm	6.87	10.99	5.08	11.92	9.43	8.12	4.57	3.23		3.05	9.46	25.47	12.62	7.54	14.73
Clay, <0.004 mm	11.26	12.22	7.24	11.37	8.51	7.61	6.28	4.43		5.03	10.11	25.42	55.71	26.68	80.15

Ocean Dumping Extra Points Protocol	Sampling Station													
	SE-20	SE-22	SE-30	SE-34	SE-37	SE-38	SE-46	SE-47	SE-64	SE-64-67	SE-67	SE-68	PP-1	PP-2	PP-3
>2 mm	30.54	0.11	23.47	0.45	0.95	7.28	37.81	35.62	0.69	37.24	6.66	8.72	2.88	18.48	0.00
<2.00 mm	5.73	0.06	5.82	0.34	2.09	2.76	4.62	5.03	99.31	5.72	6.09	0.07	2.11	8.93	0.10
<1.00 mm	8.37	0.71	9.34	2.10	5.05	4.64	9.92	6.33		8.84	9.64	0.60	4.41	9.68	0.35
<0.500 mm	10.24	3.66	12.47	5.58	8.08	7.51	12.24	8.54		9.38	14.31	6.25	7.82	11.11	0.98
<0.250 mm	14.44	16.51	24.55	14.89	22.87	19.33	13.02	15.37		13.43	23.61	15.96	9.71	11.64	2.07
<0.125 mm	12.54	55.71	12.03	53.36	43.03	42.75	11.56	21.45		17.31	20.13	17.51	4.74	5.93	1.62
<0.063 mm	6.88	10.99	5.08	11.91	9.42	8.12	4.57	3.23		3.05	9.45	25.47	12.63	7.55	14.73
<0.004 mm	1.53	1.29	0.83	1.23	0.91	0.89	0.97	0.54		0.68	1.67	3.17	8.94	4.13	13.19
<0.002 mm	9.73	10.96	6.41	10.14	7.60	6.72	5.29	3.89		4.35	8.44	22.25	46.77	22.55	66.96

Table 11. Macrofaunal abundance observed at farm and reference sampling stations at Sir Edmund Bay, British Columbia (Van Veen grab survey).

Taxon	Sampling Stations																
	SE-20	SE-22	SE-30	SE-34	SE-37	SE-38	SE-46	SE-47	SE-58	SE-64(1)	SE-64(2)	SE-64-67	SE-67	SE-68	SE-78	PP-1	PP-2	PP-3
	(Organisms m^{-2})																	
CNIDARIA	0	0	0	0	0	0	0	0	30	0	0	0	10	0	0	0	20	0
NEMATODA	5820	5380	5240	16410	7120	4670	11150	30100	118510	40	11850	79150	630	5530	42500	6340	3620	1930
ANNELIDA																		
Polychaeta	6460	5200	5720	6690	4130	3260	4900	4010	14680	0	25630	5950	6030	18780	6560	20820	6810	12770
Oligochaeta	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
Hirudinoidea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOLLUSCA																		
Bivalvia	4430	5520	2880	1330	40	150	580	530	530	10	30	70	20	20	70	160	340	340
Gastropoda	110	140	50	540	260	30	10	20	60	0	0	20	0	0	10	230	220	320
Other Mollusca	190	280	0	20	0	0	0	0	0	0	0	0	0	0	0	10	60	0
ARTHROPODA																		
CRUSTACEA																		
Copepoda	80	20	70	150	30	170	90	70	1890	0	50	10	0	1050	9180	140	60	70
Ostracoda	350	510	160	60	10	0	100	10	30	0	0	0	0	10	110	490	370	20
Cumacea	30	20	30	190	30	30	0	10	10	0	10	0	0	0	0	420	110	20
Tanaidacea	150	210	190	0	0	0	0	0	0	0	0	0	0	0	0	1270	380	470
Isopoda	110	40	80	0	10	0	0	10	0	0	10	0	0	0	10	270	180	320
Amphipoda	120	180	210	390	140	50	350	90	110	10	270	30	10	30	520	920	200	1140
Decapoda	0	10	0	10	0	10	0	0	0	0	0	0	0	0	0	0	10	0
Other Arthropoda	40	0	10	20	0	0	0	0	30	0	10	10	20	10	40	20	30	0
ECHINODERMATA	30	0	30	30	0	0	0	0	0	0	10	0	0	0	0	0	0	10
Miscellaneous Phyla	90	170	360	30	40	10	30	20	300	0	50	60	10	0	10	4990	1280	6130
Unidentified Eggs and Larvae	100	0	90	290	10	120	70	0	500	0	490	330	30	40	670	0	10	10

Table 12. Benthic debris descriptions of macrofaunal samples collected at farm and reference sampling stations at Sir Edmund Bay, British Columbia (Van Veen grab survey).

Station	Benthic Debris Description
SE-20	Sand, gravel (to 2.5 cm), worm tube fragments, organic debris, wood fragments (to 1.0 cm; <75% charcoal), and shell fragments. 2650 mL.
SE-22	Sand, wood fragments (to 4.0 cm; <25% charcoal), worm tube fragments, organic debris, shell fragments (to 2.0 cm), and gravel (to 1.0 cm). 700 mL.
SE-30	Sand, gravel (to 5.0 cm), worm tube fragments, wood fragments (to 6.[illegible] cm; ~25% charcoal), organic debris, and shell fragments (to 1.5 cm). 2800 mL.
SE-34	Sand, gravel (to 1.5 cm), shell fragments (2.5 cm), wood fragments (to 2.5 cm; ~50% charcoal), worm tube fragments, and organic debris. 1500 mL.
SE-37	Sand, gravel (to 13.0 cm), worm tube fragments, organic debris, wood fragments (to 3.5 cm; <25% charcoal), and shell fragments (to 2.5 cm). 2900 mL.
SE-46	Sand, gravel (to 8.0 cm), organic debris, worm tube fragments, shell fragments (to 3.0 cm), wood fragments (to 5.0 cm; <50% charcoal), and fish bones (vertebrae and jaws with teeth). 2100 mL.
SE-47	Sand, gravel (to 4.0 cm), worm tube fragments, organic debris, wood fragments (to 3.5 cm; <50% charcoal), shell fragments (to 1.5 cm), and fish bones. 2300 mL.
SE-58	Sand, gravel (to 8.5 cm), organic debris, worm tube fragments, and shell fragments (to 2.0 cm). 3250 mL.
SE-64	Organic debris, sand, gravel (to 11.0 cm), wood fragments (to 15.0 cm), shell fragments (to 1.5 cm), and worm tube fragments. 750 mL.
SE-64	Gravel (to 9.0 cm), sand, worm tube fragments, organic debris, wood fragments (to 10.5 cm; <25% charcoal), shell fragments (to 1.5 cm), and foraminiferan tests. 4800 mL.
SE-64-67	Sand, gravel (to 9.0 cm), worm tube fragments, wood fragments (to 2.5 cm; ~50% charcoal), organic debris, and shell fragments (2.0 cm). 2950 mL.
SE-67	Sand, gravel (to 5.0 cm), organic debris*, wood fragments (to 30.0 cm; >50% charcoal), worm tube fragments, shell fragments (to 1.0 cm), SE-67 caused headaches and respiratory problems for handlers who did not wear a half mask with cartridges effective against organic vapours. 2250 mL.
SE-68	Organic debris, wood fragments (to 11.5 cm; <25% charcoal), shell fragments (5.0 cm), sand, gravel (to 4.0 cm) and worm tube fragments. 2800 mL.
SE-78	Organic debris, wood fragments (to 13.0 cm; <25% charcoal), shell fragments (to 6.5 cm), sand, gravel (to 1.5 cm), and worm tube fragments. 2900 mL.
PP-1	Sponge fragments, organic debris, wood fragments (to 2.0 cm; <10% charcoal), worm tube fragments, clay, gravel (to 0.5 cm), and shell fragments (to 1.0 cm). 1550mL.
PP-2	Sand, gravel (to 7.0 cm), organic debris, worm tube fragments, wood fragments (to 1.5 cm; <25% charcoal), clay balls, and shell fragments (to 0.5 cm). 1700 mL.
PP-3	Sponge fragments, organic debris, wood fragments (to 14.0 cm), clay, shell fragments (to 2.0 cm), and worm tube fragments. 2350 mL.

*Some of the organic debris in this sample was tentatively identified as fish food filler, by Alex Williams, of Anadara Biological Services.

Table 13. Vertical profiles of sediment sulphide concentrations and redox potentials collected at farm and reference sampling stations at Sir Edmund Bay, British Columbia (Gravity core survey).

	Sampling Stations																		
Depth	SE-20	SE-22	SE-30	SE-34	SE-34(2)	SE-38	SE-44	SE-46	SE-47	SE-48	SE-54	SE-55-56	SE-58	SE-64	SE-64(2)	SE-64-67	SE-67	PP-1	PP-2	PP-3
(cm)	S^2 concentration (μM)																			
1	58.6	155	63.7	540	520	450	275	532	344	369	440	344	320	708	5830	800	852	26.7	10.8	0.000
3	79.8	119	85.5	570	1330	467	382	316	390	482	290	329	566	Rock	7590	596	607	28.4	32.6	5.11
5	109	161	160	265	681	398	154	103	159	372	98.8	224	410	840	9130	408	Hole	16.0	35.1	17.3
7	96.8		111		193	68.2	87.5	80.6		232	60.8	258	Rock	668	8810	242	512	56.9	35.0	50.4
9	53.3		164		94.8	73.8		85.5		98.9	70.2	222	129	367	2360	94.6	377	78.0	31.8	29.9
11			44.5		85.7			84.3			65.3			185	1010	89.5	314			37.8
13														130	908	78.9	203			38.0
15															773		147			29.1
17																				35.2
19																				40.6
21																				39.5

	Sampling Stations																		
Depth	SE-20	SE-22	SE-30	SE-34	SE-34(2)	SE-38	SE-44	SE-46	SE-47	SE-48	SE-54	SE-55-56	SE-58	SE-64	SE-64(2)	SE-64-67	SE-67	PP-1	PP-2	PP-3
(cm)	Redox Potential (mV)																			
1	247.2	209.6	393.9	163.5	91.3	-79.7	181.3	-76.9	12.2	-92.7	135.8	-58.3	-81.9	-55.8	-248.7	-232.6	-115.7	189.9	131.1	517.9
3	164.1	112.2	164.0	86.4	-103.7	-52.8	90.0	-23.6	35.9	-113.3	98.2	-16.5	27.8	-96.2	-262.6	-97.6	-129.6	143.8	126.1	177.0
5	62.0	56.3	191.1	-105.2	-2.2	-20.9	2.6	-100.5	24.5	-23.2	125.5	-96.3	-91.7	-127.5	-302.2	123.7	-123.2	153.0	120.1	164.0
7	79.1		154.5		-64.3	-62.6	54.7	-102.0		-28.4	157.3	-85.7	Rock	-134.1	-146.6	-126.1	-105.0	110.6	136.6	92.7
9	137.4		149.2		-57.7	-44.0		-55.4		-83.0	200.6	-88.6	-40.9	-137.1	-255.2	-125.5	179.9	80.0	124.7	114.9
11			118.6		35.1			-16.0			127.7			-121.5	-204.0	-126.2	-159.2			137.6
13														-120.6	-224.4	-86.0	-132.0			178.3
15															-193.7		-24.6			115.9
17																				137.6
19																				99.4
21																				132.3